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Safety and control devices for gas burners and gas-burning appliances — Particular requirements —

Part 4: Valve-proving systems for automatic shut-off valves

Dispositifs de contrôle et de sécurité pour les brûleurs à gaz et pour les appareils utilisant le gaz — Exigences particulières —

Partie 4: Systèmes de contrôle d'étanchéité pour robinets automatiques de sectionnement

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 23551-4 was prepared by Technical Committee ISO/TC 161, *Control and protective devices for gas and oil burners and gas and oil burning appliances*.

ISO 23551 consists of the following parts, under the general title *Safety and control devices for gas burners and gas-burning appliances — Particular requirements*:

— *Part 1: Automatic valves*

— *Part 2: Pressure governors*

— *Part 3: Gas/air ratio controls, pneumatic type*

— *Part 4: Valve-proving systems for automatic shut-off valves*

Introduction

This part of ISO 23551 is to be used in conjunction with ISO 23550:2004. This part of ISO 23551 both refers to and modifies clauses of ISO 23550:2004; the latter are indicated by stating that the clause of this part of ISO 23551 includes additions to, modifications of or replacements of the corresponding clause in ISO 23550:2004.

Safety and control devices for gas burners and gas-burning appliances — Particular requirements —

Part 4:
Valve-proving systems for automatic shut-off valves

1 Scope

This part of ISO 23551 specifies safety, constructional and performance requirements of valve-proving systems, hereafter referred to as VPS, intended for use with gas burners and gas-burning appliances. It also describes the test procedures for checking compliance with these requirements and provides information necessary for the purchaser and user. This part of ISO 23551 applies to all types of VPS which are used for the automatic detection of leakage in a gas burner section having at least two valves designed in accordance with ISO 23551-1 and which give a signal if the leakage of one of the valves exceeds the detection limit.

This part of ISO 23551 applies to VPSs with a declared maximum working pressure up to and including 500 kPa for use in systems using fuel gases.

This part of ISO 23551 does not apply to VPSs for use in explosive atmospheres.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 23550:2004, *Safety and control devices for gas burners and gas-burning appliances — General requirements*

ISO 23551-1:—[1)], *Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 1: Automatic valves*

IEC 60529:2001, *Degrees of protection provided by enclosures (IP Code)*

IEC 60730-1:2003, *Automatic electrical controls for household and similar use — Part 1: General requirements*

IEC 60730-2-5:2004, *Automatic electrical controls for household and similar use — Part 2-5: Particular requirements for automatic electrical burner control systems*

IEC 60730-2-6:1991, *Automatic electrical controls for household and similar use — Part 2: Particular requirements for automatic electrical pressure sensing controls including mechanical requirements*

IEC 61000-4-5:2001, *Electromagnetic compatibility (EMC) — Part 4-5: Testing and measurement techniques — Surge immunity test*

1) To be published.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
valve proving system
VPS
system to check the effective closure of automatic shut-off valves by detecting leakage, that often consists of a programming unit, a measuring device, valves and other functional assemblies

3.2
VPS programming unit
unit which follows a predetermined sequence of valve proving actions

3.3
detecting device
device for direct or inferential detection of leakage, e. g. by measuring flow or pressure

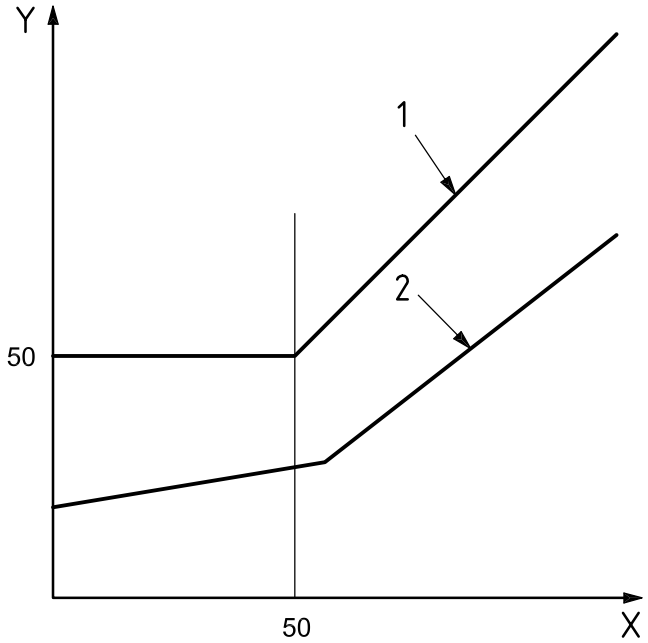
3.4
VPS operational time
time taken by the VPS to perform its entire cycle of operation

3.5
detection limit
maximum amount of leakage that can occur before the VPS is required to give a signal

NOTE See Figure 1.

3.6
detection setting
actual leakage rate setting specified by the manufacturer at which the VPS gives a signal

NOTE See Figure 1.



Key
X burner heat, gas flow, expressed in cubic metres per hour
Y detected leakage rate, expressed in cubic decimetres per hour
1 detection limit
2 detection setting

Figure 1 —Illustration of detection limit and detection setting

3.7
leakage testing time
time in which the VPS monitors a gas valve for leakage

3.8
volatile lock-out
safety shut-down condition of the system, such that a restart can be accomplished only by either the manual reset of the system or an interruption of the main power and its subsequent restoration

3.9
non volatile lock-out
safety shut-down condition of the system, such that a restart can be accomplished only by a manual reset of the system and by no other means

4 Classification

There is no classification.

5 Test conditions

ISO 23550:2004, Clause 5, applies, with the following addition.

The error of measurement shall not exceed

— for time measurements: ± 0,1 s,

— for temperature measurements: ± 1 K,

— for supply frequency measurements: ± 0,1 Hz,

— for electrical supply measurements: ± 0,5 %.

All measurements shall be made after stable temperature conditions have been achieved.

6 Construction

6.1 General

ISO 23550:2004, 6.1, applies, with the following addition.

The VPS shall be designed such that changes in critical circuit component values (such as those affecting timing or sequence) within the component manufacturer's declared worst case tolerances, including the long-term stability, shall result in the system continuing to function in accordance with this part of ISO 23551. Compliance shall be checked by worst-case analysis.

The construction of any additional functions included in the VPS for which no provisions exist in this part of ISO 23551 shall be such that they do not degrade the safe and correct operation.

Where components are used to complete the VPS, these components shall comply with the relevant component International Standard. Valves (e. g. for pressurizing and relieving the test section) integrated into the VPS functional sequence shall comply with ISO 23551-1:—, class A, and pressure-sensing devices, with IEC 60730-2-6:1991.

6.2 Construction requirements

ISO 23550:2004, 6.2, applies.

6.3 Materials

ISO 23550:2004, 6.3, applies.

6.4 Gas connections

ISO 23550:2004, 6.4, applies.

6.5 Electrical material

6.5.1 Degree of protection

The class of protection for a system with its own enclosure shall be a minimum of IP 40 as specified in IEC 60529:2001 when installed in accordance with the manufacturer's instructions. For systems used in the open air, the protection shall conform to at least IP 54 when installed in accordance with the manufacturer's instructions. For systems without enclosure, equivalent protection shall be provided by the appliance in which it is installed.

6.5.2 Switches

ISO 23551-1:—, 6.5.2, applies.

6.5.3 Power-saving circuit

ISO 23551-1:—, 6.5.4, applies.

6.6 Additional constructional requirements for VPS systems

6.6.1 Signal for indication

A signal for indication, e.g. optical indication, shall be given when the leakage exceeds the detection limit.

6.6.2 VPS setting

The setting of a detecting device shall require the use of tools. If the VPS is adjustable, the manufacturer shall supply information for its setting, e. g. detection setting.

7 Performance

7.1 General

ISO 23550:2004, 7.1, applies, with the following addition.

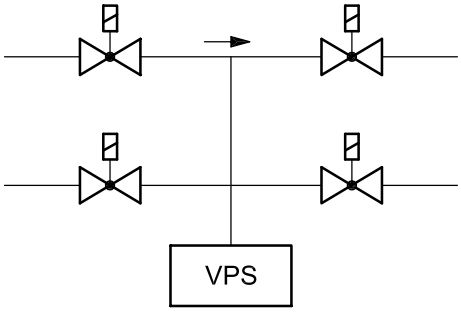
Where components are used to complete the VPS, these components shall comply with the relevant component International Standard.

7.2 Leak-tightness

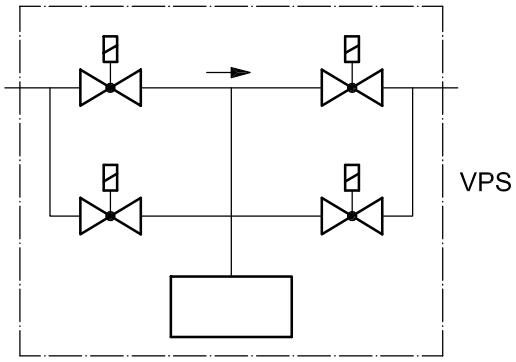
7.2.1 Criteria

A VPS shall be leaktight. A VPS is considered to be leaktight if no single component of a VPS has an external leakage rate no higher than 60 $cm^3 \cdot h^{-1}$, unless a lower value is specified in the relevant component International Standard.

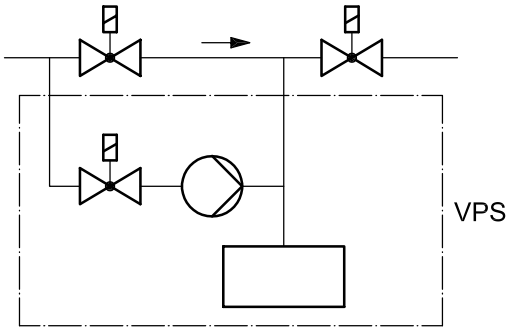
An integrated VPS is considered to be a single component. Integrated VPS shall have a leakage rate no higher than 120 $cm^3 \cdot h^{-1}$.



a) External valves supervised by a VPS



b) VPS with integrated valves



c) VPS with partly integrated valves

Figure 2 — Examples of VPS configurations

7.2.2 Test for leak-tightness

7.2.2.1 General

ISO 23550:2004, 7.2.2.1, applies, except the 3rd paragraph.

7.2.2.2 External leak-tightness

ISO 23550:2004, 7.2.2.2, applies.

7.3 Torsion and bending

ISO 23550:2004, 7.3, applies.

7.4 Rated flow rate

ISO 23551-1:—, 7.4, applies.

7.5 Durability

ISO 23550:2004, 7.5, applies.

7.6 Functional requirements

7.6.1 General

The VPS shall allow the opening of the valves to the burner and subsequent ignition below the detection limit. The VPS shall prevent the opening of the valve and operation of the ignition system when the detection limit is exceeded.

Interruption of the mains supply and its restoration shall not affect the safety of the programme sequence. If mains interruption and its restoration result in automatic recycling and overriding of any interlock, the VPS shall restart from the beginning of the programme sequence.

7.6.2 Programme sequence

The programme sequence for the VPS shall enable ignition and opening of the valves to operate the burner below the detection limit, and shall prevent ignition and opening of the valves when the detection limit is exceeded, in accordance with 7.6.5, followed by a lock-out. The lock-out may be executed on the system application direct or by the VPS itself. An automatic start-up attempt by a control function shall not override the lock-out conditions.

Any gas necessary for the operation of the VPS may be discharged into the combustion chamber during the programme sequence if the maximum release volume, expressed in litres per switching sequence, does not exceed 0,05 % of the burner heat input referred to the nominal volume flow, expressed in cubic metres per hour.

However, when the VPS is used as an alternative for pre-purge or post-purge, discharge of the gas necessary for the operation of the VPS into the combustion chamber may not be allowed; the gas shall be vented into the atmosphere at a safe location.

If the actuating energy in the safety circuit fails, the VPS shall close the main gas valves and any ignition gas valve or give a shut-down signal to the automatic gas-burner control system.

7.6.3 Timing

The leakage testing time shall be declared by the manufacturer.

Adjustment of safety critical timing is permitted but shall be possible only by means of or accessible using tools.

Where these times can be adjusted using an existing scale on the component, the scale shall be accurate to ± 10 % of the indicated value. The means of adjustment shall be readily identifiable (e. g. colour-coded).

Shortening of leakage testing time, causing conflict with 7.6.5 of this part of ISO 23551, shall not take place due to internal failures such as wear and tear, drop in accuracy of adjustments and similar causes.

Leakage testing time shall not be less than the value declared by the manufacturer.

Lengthening of valve energization time or pumping time, causing conflict with 7.6.5 of this part of ISO 23551, shall not take place due to internal failures such as wear and tear, drop in accuracy of adjustments and similar causes.

During the programme, this valve shall not be energized longer than 3 s.

Pressure pump time shall not be greater than the time declared by the manufacturer.

The response time to achieve safety shutdown, whenever this is required, shall not exceed 1 s after a functional failure has been detected.

The reaction time to achieve volatile lock-out or non-volatile lock-out, whenever required, shall be in accordance with the appliance International Standard. However, this time shall be achieved within 30 s of the safety shut-down.

The VPS operational time shall not change by more than ± 50 % under test conditions specified in Clause 5.

7.6.4 Testing of the programme sequence and timing

The test is performed on one VPS. The VPS is tested in a suitable testing unit.

With the VPS in the delivered state, the entire programme sequence (7.6.2 and 7.6.3) of the VPS is started at the rated voltage and at ambient temperature.

The programme sequence shall be tested over the voltage and temperature ranges in accordance with Clause 5.

If appropriate, the programme sequence of the VPS shall be assessed with the automatic burner control system.

7.6.5 Detection limit

7.6.5.1 General

The VPS shall prevent ignition and the opening of the burner valves at a leakage-rate limit depending on the burner heat input, starting over 50 $dm^3 \cdot h^{-1}$ and up to a minimum value of 0,1 % of the burner heat input.

7.6.5.2 Test of the detection limit

Conformity is checked by measuring the actual or inferred detection limit at three values; at 50 $dm^3 \cdot h^{-1}$, at the maximum value and at the midpoint and/or the minimum value declared by the manufacturer.

7.6.6 Self-checking

The VPS shall have an automatic internal self-checking function for each cycle. Where gas pressure switches are used, the contact position shall be checked. If internal faults simulate a correct function, the signal for ignition and the opening of the valves (see 8.12) shall not be given.

7.6.7 Lock-out and reset device

7.6.7.1 General

The lock-out may be executed at a system-application level or by the VPS itself.

A lock-out caused by the VPS can be either a non-volatile or a volatile lock-out action (depending on the requirements of the applicable appliance International Standard).

7.6.7.2 Lock-out device

The lock-out device shall be checked during each start-up sequence. In case of a mechanical actuator, a test up to the switching contacts is sufficient.

If the test fails, the system shall proceed to safety shut down.

7.6.7.3 Reset device

The system shall be so constructed that a restart attempt following non-volatile lock-out shall be possible only following a manual reset, e.g. with an integrally or remotely mounted reset button.

Misuse or tampering with the reset device, whether integrally or remotely mounted (e.g. continuous pressing of the manual reset button or an internal fault of the reset device) or shorting of the connecting cables to the reset device, or between the connecting cables and earth, shall not cause the system to operate outside the requirements of this part of ISO 23551 or prevent it from going to shut-down or lock-out.

7.7 Endurance

7.7.1 Endurance requirement

All components of the system shall be able to withstand 250 000 operations (255 000 where vibration is declared) and still comply with this part of ISO 23551. Parts that are actuated by manual reset shall be able to withstand 5 000 cycles. This requirement shall be checked by carrying out the tests detailed in 7.7.2.2.

7.7.2 Test of endurance

7.7.2.1 General

The tests specified in 7.7.2.2 and 7.7.2.3 shall be carried out on different test samples. The tests as described in 7.6.4 shall be carried out before and after the long-term performance tests of 7.7.2.2 and 7.7.2.3. Additionally, on completion of the tests described in 7.7.2.3, the tests described in IEC 60730-1:2003, 13.2.2 through 13.2.4 shall be carried out.

7.7.2.2 Thermal stress test for the VPS electronic circuit

The thermal stress test shall be carried out with the terminals loaded with the loads and power factors as declared by the manufacturer.

The system shall be tested under the following conditions:

During the tests a), b), c) and d) described below, the system shall be operated in such a way that the normal VPS sequence is performed. The time that the system is held in the stand-by (if applicable) position and the time that the control loop is interrupted before the cycle is repeated shall be agreed between the manufacturer and the test authority.

a) The purpose of this test is to cycle components of an electronic circuit between the temperature extremes likely to occur during normal use and which may result from ambient temperature variation, mounting surface temperature variation, supply voltage variation, or the change from an operating condition to a non-operation condition or vice versa.

   The following conditions shall form the basis of this test.

   — Duration of test: 14 days at thermal and electrical conditions.

   — Electrical conditions:

     The system is loaded according to the ratings declared by the manufacturer, the voltage then being increased to 110 % of the maximum declared rated voltage except that for 30 min during each 24 h period the voltage is reduced to 90 % of the minimum declared rated voltage. The changes of voltage shall not be synchronised with the change of temperature. Each 24 h period shall also include at least one period of approximately of 30 s during which the supply voltage is switched off.

   — Temperature conditions:

     The ambient temperature and/or the mounting-surface temperature are varied between the maximum declared ambient temperature or 60 °C, whichever is higher, and the minimum declared ambient temperature or 0 °C, whichever is lower, to cause the temperature of the components of the electronic circuit to be cycled between the resulting extremes. The rate of ambient and/or mounting-surface temperature change shall be in the order of 1 °C/min and the extremes of temperature maintained for approximately 1 h.

     Care shall be taken to avoid the occurrence of condensation during this test.

   — Operating conditions:

     During the test, the system shall be cycled through its operational modes at the fastest possible rate up to a maximum of 6 cycles/min because of the need to cycle components between their temperature extremes.

     The number of cycles of operation shall be recorded during this test and if this number is less than 45 000 the remaining cycles shall be executed at the declared rated voltage and at ambient temperature.

b) 2 500 operations at the maximum declared ambient temperature or 60 °C, whichever is higher, and at 110 % of the maximum declared rated voltage.

c) 2 500 operations at the minimum declared ambient temperature or 0 °C, whichever is lower, and at 85 % of the minimum declared rated voltage.

d) 5 000 operations with the VPS forced to go to lock-out and reset from each operation cycle.

e) When resistance to vibration is declared by the manufacturer, the following sinusoidal vibration test shall be carried out:

The purpose of the test is to demonstrate the ability of the system to withstand the long-term effects of vibration at levels declared by the manufacturer.

During the exposures the system shall be mounted on a rigid fixture by means of the specified fastening arrangement. The test is performed with the following minimum severity conditions:

— frequency range: 10 Hz to 150 Hz;

— acceleration amplitude: 1 g or higher, if declared by the manufacturer;

— sweep rate: 1 octave per minute;

— number of sweep cycles: 10;

— number of axes: 3, mutually perpendicular.

The systems shall be in the start position during the exposure. A performance test as described in 8.5 shall be carried out towards the end of each exposure. A visual inspection shall be carried out after the termination of the exposure. No mechanical damage shall be found.

By agreement between the manufacturer and the test authority, the timings used during the above tests may be chosen to be as short as practicable so that the endurance test is not unnecessarily prolonged.

If times have been shortened (see above), on completion of the endurance test, the VPS shall meet the requirements mentioned in 7.6.4.

7.7.2.3 Long term performance test of the complete VPS system as declared by the manufacturer for electronics and all relevant mechanical parts

The VPS manufacturer shall carry out and declare that the VPS has completed a minimum of 250 000 VPS sequences with the terminals loaded with the loads and power factors as declared, without failure. The endurance test shall be performed at the maximum test pressure and at the most unfavourable position declared by the manufacturer (if applicable).

The VPS shall have been tested under the following conditions:

a) 150 000 VPS sequences at the declared rated voltage and at ambient temperature;

b) 50 000 VPS sequences at the maximum declared ambient temperature or 60 °C, whichever is higher, and at 110 % of the maximum declared rated voltage;

c) 50 000 VPS sequences at the minimum declared ambient temperature or 0 °C whichever is lower, and at 85 % of the minimum declared rated voltage.

The times used during the above tests may be chosen to be as short as practicable so that the endurance test is not unnecessarily prolonged.

If times have been shortened (see above), on completion of the endurance test, the timings shall meet the requirements as mentioned in 7.6.4.

The corresponding leakage value (test value), based on the setting value at the start of the endurance test, shall not have changed by more than ± 30 % at the end of the test.

8 EMC/Electrical requirements

8.1 Protection against environmental influences

ISO 23550:—, 8.1, applies, with the following additions:

a) Assessment criterion I:

When tested at the severity levels given in 8.2 to 8.9, the VPS shall continue to function in accordance with requirements of this part of ISO 23551. It shall neither proceed to shut-down or lock-out, nor shall it reset from lock-out.

b) Assessment criterion II:

When tested at the severity levels given in 8.2 to 8.4, the VPS shall either be according to criterion I or it may proceed to shut-down followed by an automatic restart, or if in a volatile lock-out, it may proceed to an automatic restart.

When tested at the severity levels given in 8.5 to 8.9, the VPS shall either be in accordance with criterion I or it may proceed to shut-down followed by an automatic restart, or if in a volatile lock-out, it may proceed to an automatic restart. Any defect of the system is not allowed.

The test levels given in this part of ISO 23551 are for general applications and environments. To ensure the safe use of gas in harsher environments, only criterion I should be used.

When a particular control standard does not exist, the relevant requirements related to the assessment criteria of this clause should be agreed between manufacturer and test agency.

8.2 Variations in supply voltage

ISO 23550:2004, 8.2, applies.

8.3 Short-term voltage interruptions and drops

ISO 23550:2004, 8.3, applies with the addition of the following.

Test conditions:

a) during powering of the actuating member;

b) during valve leakage testing time;

c) in the lock-out position.

Between the voltage dips, short interruptions and voltage variations, a waiting time of at least 10 s shall be observed.

8.4 Variations in supply frequency

ISO 23550:2004, 8.4, applies.

8.5 Surge immunity test

ISO 23550:2004, 8.5, applies with the addition of the following.

Test conditions:

The five pulses of each polarity (+, –) and each phase angle as described in IEC 61000-4-5:2001 are delivered in the following order:

— 2 pulses with the system in the lock-out position;

— 1 pulse with the system in stand-by position (if applicable);

— 2 pulses randomly applied during the VPS sequence.

8.6 Electrical fast transient/burst

ISO 23550:2004, 8.6, applies with the addition of the following:

Test conditions:

The test shall be performed for 20 cycles during the VPS sequence. The test shall also be performed for a minimum of 2 min with the system in the lock-out position and with the system in the stand-by position (if applicable).

8.7 Immunity to conducted disturbances

ISO 23550:2004, 8.7, with the addition of the following.

Test conditions:

— stand-by position (if applicable);

— VPS sequence position;

— lock-out position.

8.8 Immunity to radiated fields

ISO 23550:2004, 8.8, applies with the addition of the following.

Test conditions:

— stand-by position (if applicable);

— VPS sequence position;

— lock-out position.

8.9 Electrostatic discharge immunity test

ISO 23550:2004, 8.9, applies with the addition of the following.

Test conditions:

— stand-by position (if applicable);

— VPS sequence position;

— lock-out position.

8.10 Power frequency magnetic field immunity test

ISO 23550:2004, 8.10, applies.

8.11 Electrical requirements

For electrical requirements, ISO 23550:2004, 8.11, applies.

8.12 Protection against internal faults

8.12.1 Internal fault behaviour

Safety-related hardware and software of the VPS system shall comply with IEC 60730-2-5:2004, Annex H. During this examination, the VPS response in case of detected fault/error, software fault/error detection time as well as the indication of an unsafe state shall be as given in this part of ISO 23551.

8.12.2 Definition of an unsafe state

For a VPS, an internal fault is considered as unsafe in the following cases:

a) if during burner shut-down, the gas flow through a valve or by-passing valve is higher than the detection limit value of that valve except for the function of the VPS;

b) if a test for leakage is outside the limits defined in this part of ISO 23551;

c) overriding the VPS sequence control of the safety shut-off valves by the burner control unit, except for the normal function of the VPS;

d) preventing the VPS from going to a defined fault response.

8.12.3 VPS response in case of detected fault/error

After a fault is detected, the VPS shall execute one of the following safety actions:

a) the VPS becoming inoperative with ignition terminals and all valve terminals de-energized;

b) execution of a safety shut-down within 1 s followed by a non-volatile or volatile lock-out. The lock-out may be executed by the VPS, or by another control within the appliance preventing the burner start up. During subsequent reset action, the VPS is not allowed to operate any valves or the pressurizing pump belonging to the valve. Subsequent reset from the lock-out condition under the same fault condition results in the VPS returning to the volatile or non-volatile lock-out condition;

c) the VPS continuing to operate, the fault being identified during the next start-up sequence or within 24 h, the result being a) or b);

d) the VPS remaining operational in accordance with all other requirements of this part of ISO 23551.

8.12.4 Software fault/error detection time

VPS or safety-related (hardware) parts of the VPS that are not powered during the stand-by and the running state of the appliance shall execute all relevant internal tests during powering-up of the VPS. Once the VPS is operational, the required internal test to detect the first faults leading to one of the unsafe states as mentioned in 8.12.2 shall be executed every 3 s.

For this type of VPS system, the second fault shall only be considered to occur when a start-up sequence has been performed between the first and the second fault.

VPS systems that are powered during stand-by or running state shall comply with the following:

— reaction time to detect the first faults leading to one of the unsafe states as mentioned in 8.12.2, $\leqslant$ 3 s;

— reaction time to detect second independent fault, $\leqslant$ 24 h.

VPSs that are only suitable for appliances for non-permanent operation shall execute the internal secondary test prior to every VPS test sequence.

9 Marking, installation and operating instructions

9.1 Marking

The VPS and/or its components shall be durably marked in a clear and visible position with the following:

a) name of manufacturer and/or registered trademark;

b) type reference;

c) maximum working pressure, expressed in pascals or kilopascals;

d) nature of supply and frequency;

e) rated voltage or rated voltage range;

f) degree of protection;

g) maximum load rating of outputs;

h) symbol of class II construction for class II VPS;

i) date of manufacture (at least the year), which may be in code.

9.2 Installation and operating instructions

One set of instructions shall be supplied with each consignment, written in the language(s) of the countries into which the VPS will be delivered. They shall include all relevant information on use, installation, operation and maintenance, in particular, the following:

a) type reference;

b) electrical data, including maximum ratings of loads on output terminals;

c) maximum and minimum permissible ambient temperature;

d) wiring diagram with clear terminal markings for the connection of the mains and/or battery supply and external wiring;

e) information on interlocks and how to reset them when the mains supply is interrupted;

f) permissible installation position;

g) diagram of the programme sequence;

h) all adjustment and setting information;

i) length and the type of cable for the connection of external components.

9.3 Warning notice

ISO 23550:2004, 9.3, applies.

ICS 27.060.20

Price based on 15 pages